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APPRAISAL OF GENETIC VARIABILITY AND CHARACTER ASSOCIATION STUDIES IN SOME EXOTIC UPLAND RICE GERMPLASM

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Abstract

The present study was undertaken to determine the nature and magnitude of the degree of association between yield and its component characters with 22 genotypes of upland rice during *Kharif* 2013, *kharif* 2014 and *Rabi* 2014-15. Maximum genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) was observed only for number of spikelet filled grain, while shoot length, test weight, grain yield, spikelet/panicle, flag leaf length and tiller per plant showed moderate GCV and PCV. High estimates of heritability coupled with high genetic advance as per cent of mean was observed for number of spikelet per panicle, spikelet filled grain, plant height, test weight, flag leaf length and grain yield per plant. Biological yield, harvest index and spikelet filled grains of different genotypes had a high degree of significant positive association with grain yield per panicle. On the basis of genetic parameters and associations 22 genotypes might be selected considering the filled grains per panicle.

Key words : Upland rice, variability, genetic parameter, correlation.

Introduction

Rice (*Oryza sativa*. L) as a cereal food stuff, provides an excellent entry point for mobilization of national and international resources to achieve the millennium goals and the recommendation of the world food summit. Production and productivity of rice is decreasing day by day due to erratic climatic condition. In such situation upland rice harbors a great genetic potential for rice improvement as subjected to subtle selection over a long period of time. But, the yield is very poor in upland rice. Therefore, need to increase the potential of yielding ability of the currently available upland rice varieties to meet the existing demand for rice by improvement of yield component traits. So, upland rice is a way of growing rice under rain fed condition with intermittent irrigation. It is system of growing high yielding rice under non puddled and non flooded condition. Development of high yielding verities requires the sufficient knowledge of existing variability with good transmitability and give the better scope of selection. The characters with high coefficient of variation and high heritability coupled with high genetic advance may be governed by additive genes and can be directly selected for improvement through simple plant selection. In contrast, the characters with low GCV, PCV, heritability and genetic advance may be used in heterosis breeding. Correlation coefficient analysis measures the degree and direction of relationship among the two traits. Correlation studies are the great value with yield for selecting the character played important role that influence the grain yield (Ajibade and Morakinyo, 2000). Thus, selection of certain trait could depend on magnitude of relationship and their heritability estimates (Sabesan *et al*., 2009). Keeping in view these perspectives, the present experiment was conducted (1) to study genetic variability among the upland rice genotypes (2) To measure the relationship between grain yield and its component traits.

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Materials and Methods

The experimental for the present study was conducting during *kharif* 2013 and *kharif* 2014 at the field experimentation centre of Department of Genetics and Plant Breeding, SHUATS, Allahabad and during *Rabi* 2014-15 at National rice research institute, Cuttack. The experimental material comprised of 22 rice genotypes and it was laid out in randomised block design with three replication. Observations were recorded for sixteen quantitative traits *viz*., days to 50% flowering, days to maturity, flag leaf length, flag leaf width, panicle length, tillers/plant, plant height, test weight, spikelets per panicle, filled spikelet/panicle, spikelet fertility, root length (20 DAS) and shoot length (20 DAS), biological yield per plant, harvest index and grain yield per plant. Standard statistical procedure were used for the analysis of variance, genotypic and phenotypic coefficient of variance (Burton, 1952), heritability (Lush, 1940), genetic advance and correlation (Johnson *et al*., 1955).

Results and Discussion

Analysis of variance revealed highly significant differences among the genotypes for all the characters except flag leaf width (table 1), indicating ample scope for the selection of different quantitative characters for rice improvement. The range and mean values for various quantitative traits are presented in table 2. Days to 50 per cent flowering ranged from 74 days (NDR 97) to 85 days (IR 82635-B-B-143-1) with grand mean 82 days. Plant height ranged from 77.66cm (NDR 97) to 118.5cm (IR 82639-BB-200-4) with grand mean 96.24cm. Number of productive tillers per plant ranged from 4.66(IR-82589-B-B-2-2) to 7.33tillers (VANDANA). Panicle length varied from 18.97cm (NDR 97) to 28.37cm (IR 82639-BB-200-4). Number of spikelet per panicle ranged from 83 ([R-82589-B-B-138-2) to 157 (IR 82639-BB-200-4) and showed wide range of variability among all the characters studied. Spikelet filled grain is highly varied from 66 (R-82589-B-B-138-2) to 135 (IR 82639-BB-200-4). Root length (20DAS) is ranged from 4.40 (IR 82589-B-B-84-3) to 7.13(IR 82639-BB-200-4). A range for harvest index and test weight varied from 43.88 (IR 82635-B-B-143-1) to 54.39 g. (IR 82589-B-B-2-3) and 14.03g ([R-82589-B-B-138-2) to 22.07g (IR 82589-B-B-95-2), respectively. Grain yield per plant had considerable range of variation, the minimum and maximum were being recorded in IR-82589-B-B-2-2 (8.77g.) and IR 82589-B-B-95-2 (13.97g.), respectively. Results on range showed the maximum variability was present for number of filled spikelet per panicle among the genotypes used in this study and diverse genotypes/varieties may be isolated for this character to govern the crossing programme for improvement of upland rice. The non significant variability was found for flag leaf width, so there is need to develop the lines/varieties having high flag leaf width because this trait is directly related to the photosynthetic rate which assimilates grain filling and showing positive significant towards the grain yield (Li *et al*., 1998).

Table 1 : ANOVA for yield and its component traits in exotic rice genotypes.

Traits	MSSR (df=2)	MSST (df=21)	MSSE (df=42)
50% flowering	7.50	65.05**	9.31
Flag leaf length	0.08	103.12**	2.29
Flag leaf width	0.001	0.16	0.009
Tiller/plant	0.64	5.41**	0.61
Maturity	6.51	64.90**	9.20
Panicle length	0.87	25.04**	1.69
Plant height	0.52	771.30**	7.33
Spikelet/panicle	2.13	2372.17**	12.16
Test wt	0.16	52.84**	0.91
Spikelet filled grain	40.09	2927.51**	23.68
Spikelet fertility %	22.56	331.46**	18.33
Root length	0.06	3.48**	0.19
Shoot length	0.15	4.33**	0.30
Biological yield	1.51	27.10**	1.40
Harvest index	1.79	107.84**	8.48
Grain yield/plant	0.75	21.44**	0.61

**and *significant at 0.01 and 0.05 level of significance. df= Degree of freedom

The genetic parameters for various quantitative traits are presented in table 3. The coefficient of variation measures the magnitude of variability present in population and depends on the heritable and non-heritable variation. In the present investigation the magnitude of PCV was higher than the GCV for all the quantitative characters, indicated that these characters were less influenced by environment. High GCV and PCV was observed for spikelet filled grain while shoot length, grain yield per plant, test weight, tiller/plant and flag leaf length show moderate GCV and PCV. Higher GCV and PCV were earlier reported by Zahid *et al.* (2006) and Pandey *et al.* (2010). Higher GCV and PCV show high variance and low effect of environment which suggest that the selection of this trait may efficient for improvement. Moderate GCV and PCV for grain yield per plant had earlier been reported by Rahman *et al.* (2012). The trait number of tillers per plant showed moderate PCV value but extent of GCV is low for this trait, indicated the higher

Table 2 : Mean table for sixteen yield and its component traits in exotic rice genotypes.

No	Traits	DFF	DM	FLL	FLW	PL	NTP	PH	TW	NSP	SFG	SF (%)	RL (20 DAS)	SL(20 DAS)	BY/P	HI	GYP
1	IR 82589-B-B-149-4	80	110	25.58	1.16	23.34	7	98.66	22.07	137.77	119.55	86.88	5.94	5.16	25.16	51.4	12.92
2	IR 82589-B-B-95-2	79.11	109.11	25.18	1.08	23.2	6.77	99.77	20.48	122.22	106.88	87.55	5.38	4.28	26.31	53.17	13.97
3	IR 82589-B-B-2-3	79.66	109.77	29.45	1.02	23.17	6.66	91.94	20.8	129.22	114.33	88.55	6.24	4.84	24.8	54.39	13.48
4	IR 82589-B-B-121-3	80.66	110.66	26.46	1.02	23.14	6.61	107.46	19.62	133.77	109.66	82.11	5.96	5.63	25.34	53.61	13.56
5	IR 82635-B-B-47-1	83.66	113.66	27.07	1.12	22.35	5.66	101.21	16.49	102.44	78.22	76.66	5.52	4.42	19.67	47.07	9.25
6	IR 82589-B-B-2-2	83.55	113.55	25.94	1.07	21.49	4.66	87.35	14.45	110.22	77.77	70.77	4.75	3.71	20.3	44.44	8.77
7	IR 84984-27-1	85.11	115.22	28.54	1.19	21.3	5.33	99.55	17.07	120.33	92.22	76.55	4.97	4.05	21.98	51.59	11.35
8	IR 82589-B-B-51-4	84.33	114.33	24.48	1.1	21.77	5.77	98.04	15.68	115	83.22	72.33	5.28	3.9	21.74	48.9	10.63
9	IR 72860-107-3-12	84.33	114.33	29.7	0.85	21.94	5.55	90.98	14.62	118.66	97.11	82	5.62	4.74	21.9	49.49	10.82
10	IR 78914-B-22-B-B-B	84.33	114.33	26.1	1.08	22.05	5.44	92.05	16.4	128.99	88.22	68.44	5.75	4.28	22.27	50.37	11.15
11	IR 82589-B-B-138-2	84	114	23.68	1.27	22.07	6.22	91	14.03	83.11	66.11	79.55	5.76	4.86	21.93	44.88	9.86
12	IR 82589-B-B-84-3	82.11	112.11	24.18	1.03	21.63	5.11	95.94	18.53	132.11	107.22	81	4.4	3.49	23.01	52.2	12.03
13	IR 82639-B-B-200-4	80.55	110.55	34.93	1.54	28.37	7	118.52	19.32	157.11	135.11	86	7.13	6.15	23.83	52.28	12.46
14	IR 82589-B-B-114-3	83.88	113.88	30.11	1.03	21.8	5.55	93.8	15.36	127.88	98	76.55	5.63	4.76	22.35	45.01	10.13
15	IR 82635-B-B-143-1	85.44	115.44	23.38	1.02	22.74	5.22	96.36	18.25	110.77	88.99	80.33	5.05	4.26	21.19	43.84	9.24
16	IR 82635-B-B-88-2	82.88	112.88	24.13	1.02	20.91	5	89.07	15.9	119.11	91.22	76.77	4.78	3.95	21.15	45.39	9.59
17	IR 83750-B-B-131-1	81.11	111.11	26.93	1.22	23.3	6.66	112.77	14.95	147.55	127.77	86.55	5.95	5.65	23.65	51.36	12.16
18	IR 82589-B-B-124-2	84.33	114.22	28.04	1.12	22.43	5.66	92.88	17.49	117.88	84	71.22	5.24	4.46	21.27	51.77	11.01
19	IR 82589-B-B-44-4	83.88	113.88	27.35	1.07	22.67	7	86.33	17.7	141.88	122.22	86.11	6.37	5.02	23.87	53.56	12.79
20	Vandana	81.33	111.33	28.3	1.08	21.98	7.33	106.87	21.44	127	108.77	85.55	6.12	5.56	23.08	53.65	12.36
21	NDR 97	74.44	104.44	18.83	0.96	18.97	5.77	77.66	17.5	111.88	94.55	84.66	5.83	4.72	23.28	53.36	12.4
22	Sahbhagi Dhan	78.55	108.55	20.78	1.04	23.5	6.55	89.06	20.54	141.44	119.66	84.77	6.1	4.01	24.86	51.17	12.72
	Mean	**82.15**	**112.15**	**26.32**	**1.09**	**22.46**	**6.02**	**96.24**	**17.67**	**124.38**	**100.49**	**80.5**	**5.63**	**4.63**	**22.86**	**50.13**	**11.48**
	C.D. 5%	2.84	2.82	1.4	0.09	1.21	0.73	2.51	0.88	3.24	4.52	3.98	0.4	0.51	1.1	2.71	0.72
	Range Lowest	74.44	104.44	18.83	0.85	18.97	4.66	77.66	14.03	83.11	66.11	68.44	4.4	3.49	19.67	43.84	8.77
	Range Highest	85.44	115.44	34.93	1.54	28.37	7.33	118.52	22.07	157.11	135.11	88.55	7.13	6.15	26.31	54.39	13.97

DFF= Days to 50 per cent flowering, DM=Days to maturity, FLL= Flag leaf length, FLW= flag leaf width, PL= Panicle length, NTP= Number of productive tillers per plant, PH= Plant height, TW= Test weight, NSP= Number of spikelets per panicle, SFG=Spikelet filled grain, SF=Spikelet fertility, RL=Root length, SL=Shoot length, BYP=Biological yield/plant, HI= Harvest index, GYP= Grain yield per plant.

Table 3 : Genetic parameters for sixteen yield and its component traits in exotic rice genotypes.

S.no.	Characters	Mean	VG	VP	GCV	PCV	h^2bs	GA	GAM
1	50% flowering	82.15	6.19	15.51	3.03	4.79	40	3.24	3.94
2	Flag leaf length	26.33	11.20	13.50	12.71	13.95	83	6.28	23.86
3	Flag leaf width	1.10	0.02	0.03	11.77	14.80	63	0.21	19.30
4	Tiller/plant	6.03	0.53	1.15	12.11	17.78	46	1.02	17
5	Maturity	112.16	6.19	15.39	2.22	3.50	40	3.25	2.90
6	Panicle length	22.46	2.59	4.29	7.17	9.22	60	2.58	11.48
7	Plant height	96.24	84.89	92.22	9.57	9.98	92	18.21	18.92
8	Spikelet/panicle	124.38	266.22	274.39	13.02	13.32	96	32.61	26.22
9	Test wt	17.67	5.77	6.68	13.59	14.63	86	4.60	26.03
10	Spikelet filled grain	100.49	322.65	346.33	17.87	18.52	93	35.71	35.54
11	Spikelet fertility %	80.50	34.79	53.13	7.33	9.05	65	9.83	12.22
12	Root length	5.63	0.37	0.56	10.74	13.28	65	1.01	17.89
13	Shoot length	4.64	0.45	0.75	14.43	18.50	59	1.06	22.92
14	Biological yield	22.87	2.86	4.27	7.39	9.03	67	2.85	12.46
15	Harvest index	50.14	11.04	19.53	6.63	8.81	57	5.15	10.27
16	Grain yield/plant	11.49	2.32	2.93	13.24	14.83	79	2.79	24.27

VG = Genotypic variance, VP=Phenotypic variance, GCV= Genotypic Coefficient of Variation, PCV= Phenotypic Coefficient of Variation, h^2bs = Heritability in broad sense, GA=Genetic advance, GAM= Genetic Advance as per cent of Mean.

effect of environment on this trait. Rest yield component traits *viz*., days to 50 per cent flowering, harvest index, biological yield, panicle length and root length exhibited low GCV and PCV estimates indicated that it may be governed by non additive genes and recombination breeding may helpful for improvement of grain yield through selection of these traits. The low GCV and PCV values for days to 50 per cent flowering was also observed by several workers *viz*., Anandrao *et al*. (2011), Paul *et al*. (2011), Singh *et al.* (2011) and Quatadah *et al.* (2012).

Heritability measures the possibility of joint transmission of two correlated characters through selection of one character. It is a measure of the relationship between parent and progeny. The most important function of the heritability in the genetic study of quantitative characters is its predictive role to indicate the reliability of the phenotypic value as a guide to breeding value (Dabholkar, 1992; Falconer and Mackay, 1996). In the present study, traits like number of spikelet/ panicle, spikelet filled grain, plant height, test weight, flag leaf length and grain yield/plant. Chaubey and Singh (1994) and Atlin (2003) showed high heritability estimate while biological yield, spikelet fertility, root length, flag leaf width, panicle length, shoot length and harvest index show moderate heritability. Therefore, selection from these traits will be valuable for further rice improvement. Days to 50% flowering and tiller/ plant showed low heritability. Estimates of heritability are more advantageous when expressed in terms of genetic advance. Johnson *et al.* (1955) predicting the resultant effect of selecting the best trait. The estimates of genetic advance help in understanding the type of gene action involved in the expression of various polygenic traits. High values of genetic advance are indicative of additive gene action, whereas low values are indicative of non-additive gene action (Singh and Narayanan, 1993). In the present study high estimates of heritability coupled with high value of genetic advance as a percentage of means was observed for plant height, flag leaf length, number of spikelet per panicle, spikelet filled grain, test weight and grain yield per plant, while root length, tiller/plant, flag leaf length and spikelet fertility showed moderate heritability coupled with moderate genetic advance as per cent of mean. Similar finding has earlier been reported by Verma (2010). Days 50% flowering showed low heritability coupled with low genetic advance as per cent of mean. Thus the heritability estimates will be reliable, if accompanied by high genetic advance.

Information regarding the nature and extent of association between component characters with grain yield per plant would be helpful to decide the major contribution towards grain yield. Yield is a complex polygenic trait for which direct selection may not effective always. So that nature and extent of association of component characters with grain yield and other component traits would be helpful in improvement of yield. The results on correlations revealed that genotypic correlation coefficient were higher than the corresponding phenotypic correlation

Table 4 : Phenotypic (upper diagonal) and genotypic (lower digonal) correlation between seed yield and its component traits in exotic rice.

Character	DFF	DM	FLL	FLW	PL	T/P	PH	TW	S/P	SFG	SF (%)	RL	SL	BY/P	HI	SY/P
DFF	**1.00**	0.99**	0.22**	0.06	0.02	-0.18*	0.10	-0.36**	-0.15*	-0.35**	-0.51**	-0.29**	-0.22*	-0.33**	-0.35**	-0.41**
DM	1.00**	**1.00**	0.23**	0.05	0.01	-0.18*	0.10	-0.36**	-0.15*	-0.35**	-0.50**	-0.29**	-0.21*	-0.33**	-0.35**	-0.41**
FLL	0.36**	0.36**	**1.00**	0.34**	0.50**	0.14*	0.51	0.01	0.36	0.28	0.01	0.30	0.36	-0.00	0.10	0.05
FLW	0.01	0.01	0.45**	**1.00**	0.47**	0.22*	0.51**	0.04	0.22*	0.19*	0.04	0.29	0.31	0.06	-0.02	0.03
PL	-0.05	-0.05	0.62**	0.72**	**1.00**	0.29**	0.57**	0.28**	0.49**	0.46	0.20*	0.44	0.39	0.30	0.10	0.25
T/P	-0.54**	-0.54**	0.25 **	0.40**	0.60**	**1.00**	0.32	0.42**	0.35	0.47	0.44	0.46**	0.39	0.45	0.34	0.49
PH	0.04	0.05	0.59**	0.65**	0.72**	0.47**	**1.00**	0.21	0.46**	0.41	0.13*	0.24	0.44**	0.19*	0.14	0.21*
TW	-0.57**	-0.57**	0.01	0.06	0.38**	0.67**	0.25**	**1.00**	0.43	0.54**	0.48**	0.28	0.21*	0.56**	0.47**	0.63**
S/P	-0.34**	-0.34**	0.39**	0.26**	0.61**	0.53**	0.45**	0.48**	**1.00**	0.88**	0.32	0.39	0.34	0.50	0.43	0.56
SFG	-0.52**	-0.51**	0.32**	0.25**	0.62**	0.73**	0.45**	0.60**	0.93**	**1.00**	0.72**	0.49**	0.43	0.61**	0.50**	0.67**
SF (%)	-0.67**	-0.66**	0.04	0.10	0.39**	0.82**	0.26**	0.62**	0.47**	0.75**	**1.00**	0.41	0.37	0.51	0.39	0.56
RL	-0.42**	-0.42**	0.40**	0.46**	0.65**	0.89**	0.35**	0.38**	0.52**	0.63**	0.58**	**1.00**	0.66**	0.32	0.28	0.38
SL	-0.29**	-0.29**	0.52**	0.49**	0.58**	0.83**	0.61**	0.27**	0.46**	0.58**	0.58**	0.86**	**1.00**	0.28	0.23	0.32
BY/P	-0.74**	-0.74**	-0.01	0.07	0.39**	0.81**	0.22*	0.72**	0.61**	0.77**	0.79**	0.55**	0.44**	**1.00**	0.42	0.84**
HI	-0.61**	-0.61**	0.14*	0.06	0.23**	0.70**	0.23**	0.67**	0.60**	0.67**	0.57**	0.50**	0.42**	0.77**	**1.00**	0.82**
SY/P	-0.72**	0.72**	0.06	0.07	0.34	0.81**	0.24	0.74**	0.64	0.77**	0.74**	0.56	0.46	0.95**	0.92**	**1.00**

**and *significant at 0.01 and 0.05 level of significance. df= Degree of freedom DFF= Days to 50 per cent flowering, DM=Days to maturity, FLL= Flag leaf length, FLW= flag leaf width, PL= Panicle length, NTP= Number of productive tillers per plant, PH= Plant height, TW= Test weight, NSP= Number of spikelets per panicle, SFG=Spikelet filled grain, SF=Spikelet fertility, RL=Root length, SL=Shoot length, BYP=Biological yield/plant, HI= Harvest index, GYP= Grain yield per plant.

coefficient, indicated the characters are governed by additive gene action and are useful in yield improvement. The association between yield and yield component traits are presented in table 4. Grain yield per plant was correlated positively and significantly with biological yield, harvest index, spikelet filled grain, test weight, spikelet fertility, no of spikelet per panicle, tiller per plant, root length, shoot length, panicle length and plant height at genotypic and phenotypic level and positively and non significant with flag leaf length and flag leaf width at both level. Eradasappa *et al.,* (2007) and Paul *et al.* (2011) also found positive correlation between grain yield and plant height. Manna *et al.* (2006) also found Grain yield per plant was positively and significantly associated with effective tiller per plant and spikelet per panicle. Days to 50 per cent flowering showed negative and significant correlation with grain yield per plant. Similar finding has earlier been reported by Seyoum *et al.* (2012). Days to 50 per cent flowering also showed positive correlation with flag leaf length, flag leaf width, panicle length and plant height. It is indicated that the late flowering genotypes had sufficient time for vegetative growth and they having god photosynthetic rate. The vigorous plants may produced panicles with good length and seed size. But in upland rice there is need to develop the early maturing varieties with good grain yield which can be achieved by selecting the early duration rice varieties/ lines and improve the other major yield contributing traits. Considering all the parameter together it could be suggested that the superior genotypes for these traits may be isolated and further utilized for rice genetic improvement.

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